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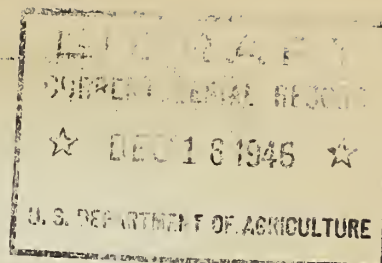
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UNITED STATES DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Summary Review of Monthly Reports\*  
for  
SOIL CONSERVATION SERVICE RESEARCH\*\*  
OCTOBER 1946



EROSION CONTROL PRACTICES DIVISION

Soil Conservation Benefits Study - H. O. Anderson, LaCrosse, Wisconsin.- "The Conservation Benefits Survey, through which production and income comparisons between soil conserving and non-conserving farms were obtained, also provided other information which may be valuable for improvement in soil conservation planning. Compliance with farm soil conservation plans was comparatively good on the group of 34 soil conserving farms. For example, the proportion of cropland in soil conserving crops was 95 percent of the planned acreage, application of limestone was within 83 percent of the amount recommended and 83 percent of the acreage of contour strip cropping had been established. About two-thirds as much commercial fertilizer as recommended was applied. On the other hand, only about 18 percent of the needed pasture improvement had been established.

"The cropping program for the soil conserving farms was definitely more soil conserving than the cropping program for the non-conserving group. On the basis of general crop rotation recommendations, however, adherence to the plans was not too good. Fewer acres of soil conserving crops and more acres of corn and small grain were raised than was needed for adequate erosion control. For example, the crop rotation recommendation for these two soil conservation districts, if applied to the 34 farms would provide for hay and rotation pasture on 64 percent of the cropland. The actual proportion of hay and rotation pasture was 51 percent in 1945."

The Spencer Soil Area - H. B. Atkinson, LaCrosse, Wisconsin.- "This area, which includes the Almena soil, comprises about 3,000,000 acres in ten counties in north-central Wisconsin. The soil is heavy, shallow, and poorly drained. The topography is gently rolling with slopes of 2 to 4 percent predominating where erosion is a problem. This soil is frequently wet in the spring. Farmers in the area have been reluctant to use contour cultivation and strip cropping as they believed that water stored in the furrows would prolong the wet spring period.

"Farmers have followed the practice of leaving frequent dead furrows up and down the slope to increase drainage. This practice on sloping land has resulted in severe erosion. The use of terraces in this area has improved field drainage. Indications are that there will be an extensive program of terrace construction in this area."

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\*\*All Research work of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

Study of Eroded Soils - Richard M. Smith, Morgantown, West Virginia.-

"Laboratory determinations are almost complete on the eroded soil samples collected from the L. U. Project in Mason County this summer. These samples are on plots where the rate of improvement from treatments is to be evaluated.

Soil	Depth	pH	Total Bases M.E.	Organic Matter %	Moisture Equivalent %	Clay Content %	Sand %
Upshur clay (alkaline)	0-1 $\frac{1}{2}$	7.7	86.8	5.5	38.5	52.5	9.3
	1 $\frac{1}{2}$ -3	7.7	61.5	3.7	35.0	55.1	6.5
	3-6	7.6	70.3	2.7	36.0	56.9	5.8
Upshur clay (acid)	0-3	5.0	19.3	2.0	26.1	45.1	17.0
	3-6	4.9	19.8	1.2	28.4	50.1	12.1
Tilsit silt loam	0-1 $\frac{1}{2}$	5.2	11.3	1.6	24.1	25+	
	1 $\frac{1}{2}$ -3	4.8	10.1	.9	23.6	25-	
	3-6	4.7	12.1	.6	25.1	25	
Muskingum sand	0-3	4.9	5.4	0.26	10.1	10.2	75.8
	3-6	4.8	4.4	0.20	10.0	9.1	75.9

"It was surprising to find that the alkaline Upshur Clay, though eroded, still contained so much organic matter. The extremely high content of active clay is evidently closely related to this and to the fact that the land is considered unfit for cultivation.

"The acid Upshur clay appeared to be somewhat more eroded and much more difficult to revegetate than the alkaline Upshur, but field observations did not even suggest the great differences in organic matter, pH and total bases shown. In fact it was only by soil testing that we discovered that this clay was an acid phase of Upshur. More work is needed to establish some practical means for separating these two kinds of Upshur, because the problems are greatly different on the two."

Removal of Topsoil Reduced Corn Growth - L. T. Kardos, Durham, New Hampshire.-"The subsoil plots at Northwood Ridge which were planted to oats last year were planted to a grain corn this year. Because of the dry July and the wet and cool August the grain did not fully mature but total yields of oven dry forage were determined on October 16 and are listed below:

Plot Treatment	Yield of Forage(lb./A.)*	
	Fertilized	Unfertilized
0% Topsoil Removed	8005	4251
50% Topsoil Removed	4022	1685
100% Topsoil Removed	2221	306

\*Average of central 4-hill samples from 16-hill duplicate plots. Corn variety. New Hampshire 500. Fertilized with 500 lb. per acre of 5-10-10 which was placed in two bands on either side of the hill.



"As in the case of the oat crop in 1945 the extremely low fertility of the subsoil is strongly demonstrated. The principal difference between the oat and corn crops was in the yield of forage on the fertilized plots with 50% of the topsoil removed. In the case of the oat crop (1945) the fertilized 0% and 50% Topsoil Removed plots were approximately the same in yield whereas with the corn crop the forage yield on the 50% Topsoil Removed plot was only one-half of that of the 0% Topsoil Removed plot.

"The results for the unfertilized plots show a decrease in yield of 60.4% when 50% of the topsoil is removed and a decrease in yield of 92.8% when 100% of the topsoil is removed."

Corn Yields on Eroded Land - B. H. Hendrickson, Watkinsville, Georgia.-"Mr. John R. Carreker has turned in the following 1946 corn yield results from certain of his experimental fields in engineering studies on land Classes III and IV. In both cases, corn was grown in the poor corn year of 1946 in an erosion-permitting 3-year rotation which includes two row crop years out of three.

Land Class	Corn yields bu/ac.	
	IV	III
Corn, after Austrian winter peas were turned under	20.4	24.0
Corn, no preceding winter cover crop	11.0	13.2

"These results are in line with many others recorded in Station tests. They indicate that soil conditioning by the use of a winter legume turned under was beneficial to corn yields even in a poor corn season. They also suggest that corn is a risky crop to grow on eroded land in this section, since at least two out of five years are likely to be dry when corn must have ample soil moisture."

Corn Yield in Tillage and Residue Studies - Ralph A. Cline, Brookings, South Dakota.-"The corn plots were harvested and the stalks cut and removed immediately from the plots. As soon as soil conditions permit these plots will be tested with the wind tunnel. Because of prevailing weather conditions it may be impossible to make these tests this fall. In case we are not able to secure this data this fall, every effort will be made to do the work as soon as the weather breaks next spring. Corn yields from the tillage and residue plots were as follows:

<u>Grain Stubble</u> <u>Left Previous Yr.</u>	<u>Moldboard</u> <u>Plowed-Bu/A</u>	<u>Oneway</u> <u>Disked-Bu/A</u>	<u>Subsurface</u> <u>Tilled-Bu/A</u>	<u>Average</u> <u>Bu./A.</u>
None	49.8	43.3	46.1	46.4
6" Stubble	47.1	41.1	43.0	43.7
6" Stubble & manure	49.2	46.1	45.1	46.8
12" Stubble	42.7	40.3	39.6	40.9
All straw returned	47.3	30.1	34.9	37.4
Average	47.2	40.2	41.8	

"Corn yields this year were very much in favor of moldboard plowing. When large amounts of straw were left on the surface the yield was reduced on all but moldboard plowed plots.

"The ear corn contained approximately 24% moisture. There was no significant difference in moisture content between tillage or residue treatments. There was, however, quite a little difference in percent of stand between tillage methods. The stand on moldboard plowed plots exceeded oneway disked plots by 13.6% and subsurface tilled plots by 15.4%. The poorest stands were recorded on subtilled and oneway disked plots where all the small grain residue had been returned. On these plots the stands were 54.0 and 45.9 respectively. It is believed that the present method of planting in heavy residue is the cause of these poor stands. It is hoped that in 1947 this situation can be eliminated."

Corn Yields as Influenced by Contour Tillage- D. D. Smith, Columbia, Missouri.-"Yield samples were secured from twelve contour corn yield trials this year. The average contour yield was 60.2 bushels per acre. This was only 1.1 bushel more than the average up-and-down hill yield. Six of these tests were on soils that are classed as slowly or very slowly permeable. For these tests the contour yield averaged 58.9 bushels per acre, or 2.2 bushels per acre less than the up-and-down hill yield. The other 6 tests were on soils that are classed as moderately or rapidly permeable. For these tests the contour yield was 61.4 bushels per acre, or 4.4 more than the up-and-down hill yields. The land slope averaged 2.4 percent for the tight soil group and 2.9 percent for the open soil group. Early growing season rainfall was excessive in several cases. This made necessary replanting of the corn."

Field Trials of Pitting and Seeding Rangeland in North Central Wyoming - O. K. Barnes, Laramie, Wyoming.-"The month of October was devoted almost entirely to establishing field trials of pitting and seeding on sagebrush range land around Lander, Riverton and Tensleep, Wyoming. This is the first time such work has been tried in north central Wyoming.

"The eccentric disc was loaded on a new, specially built trailer and hauled from Laramie to these various ranches. The disc is one purchased by the Regional office and the trailer was constructed by the state SCS mechanic.

"District personnel and county agents made prior arrangements with these ranchers. The rancher furnished the tractor and any other necessary equipment. In most instances the District furnished the grass seed. During the month this pitting and seeding was done on eight different ranches. Only five or six acres were treated per ranch.

"Numerous ranchers stopped to watch the work and requested us to come to their places and put in some pitting and seeding. However, the number of ranches and acres was held to a minimum at each location, since this is the first time we have tried pitting and seeding under their conditions.

"Four methods were used in this pitting-seeding work: (1) Dragging a harrow behind the disc to cover the seed in the pits and to pull out partially cut sagebrush. (2) Dragging a heavy log chain behind the disc to get a little less cover on the seed. (3) Just disking and seeding with no more cover than that falling behind the disc, this followed by trampling by livestock. (4) Pitting-seeding only. Crested wheatgrass was used in all cases. A little alfalfa was mixed in with the crested wheat on one ranch."

Pasture Days of Grazing and Gains in Weight of Sheep from Winter Wheat and Lespedeza - C. A. Van Doren, Dixon Springs, Illinois.-  
 "The 1946 seasonal results from supplemental grazing of winter wheat and lespedeza on the length and percent of slope plots establish beyond question the value of early spring grazing of winter cereal and the late summer grazing of lespedeza. The total seasonal gain in weight of sheep was 201.7 pounds an acre from 5% slopes and 217.9 pounds an acre from 9 percent slopes. All of this gain was secured during periods when the grass pastures in the area are unsatisfactory for grazing. Gains from grazing of winter wheat were greater than from lespedeza on both 5 and 9 percent slopes. The greater gains from winter wheat are even more significant since fewer pasture days of grazing were involved in producing the gains on winter wheat than on lespedeza. The data are shown in the following table:

Location and Slope	Winter Wheat		Lespedeza		Seasonal Total	
	Pasture(1) Days	Gains Lbs/A	Pasture(1) Days	Gains Lbs/A	Pasture (1) Days	Gains Lbs/A
<u>5% Slopes</u>						
Plots 10 - 14	189	118.0	252	42.1	441	160.1
Plots 15 - 19	216	130.1	329	113.2	545	243.3
Average	202	124.0	290	77.6	493	201.7
<u>9% Slopes</u>						
Plots 20 - 24	216	113.8	329	74.0	545	187.8
Plots 25 - 29	216	149.1	376	99.0	592	248.1
Average	216	131.4	352	86.5	518	217.9

(1) Pasture day - grazing of one sheep for one day."

Erosion Losses and Wheat Yield as Influenced by Tillage and Crop Residues - G. M. Horner, Pullman, Washington.-"Erosion losses during the past erosion season show that wheat stubble utilized as a mulch is very effective in reducing runoff and erosion. The results are given below for a series of plots on which different amounts of wheat straw were returned to the soil and two types of tillage operations performed for the initial tillage in preparing summer fallow. Weeding operations during the summer months were uniform for all plots, and the land was seeded to winter wheat.



Initial tillage for fallow	Straw Returned tons/A	Soil Losses tons/A	Water Loss In.	Wheat Yield	
				1946 bu./A	Ave. 1943-46 bu./A
Subsurface tiller	0 (burned)	44.2	4.27	30.1	34.6
Subsurface tiller	1	13.4	1.90	26.0	32.9
Subsurface tiller	2	1.3	0.47	24.4	30.6
Moldboard plow	0 (burned)	65.0	4.13	36.9	37.7
Moldboard plow	1	57.5	3.93	34.9	36.1
Moldboard plow	2	54.5	3.73	31.2	34.5

"The stubble mulch resulting from tillage with a sweep type tiller reduced soil losses to a very low value where two tons per acre of straw was utilized. A cover of one ton of straw was not as effective as the heavier mulch, but was still much better than the bare condition represented by moldboard plowing. Turning under straw with a plow did not greatly improve erosion control, compared with the burned treatment. Crop yields were decreased with increased amounts of straw utilized, and for equal quantities of straw, the moldboard plowed plots produced a higher yield than the subsurfaced tilled land. These differences were greater in 1946 than during the previous three years of the study."

Tillage of Sericea and Kudzu Stubble Land - B. H. Hendrickson, Watkinsville, Georgia.-"After combine-harvesting sericea seed and raking off the combine residue in late October, a double disking provided a satisfactory seedbed for drilling oats and vetch for winter grazing. Similarly, after mowing kudzu hay and baling directly from the swath with a pick-up baler, no trouble was experienced in preparing a seedbed with a heavy disc harrow, as soil moisture conditions were favorable."

Moisture Penetration on Fields and Pastures in the High Plains - C. J. Whitfield, Amarillo, Texas.-"As a result of the heavy rains during the month, conditions in the High Plains are excellent for winter wheat and there is probably more acreage planted to wheat than has been the case for a number of years. Penetration of moisture on various fields and pastures as determined by samples taken October 15 and 16 is as follows:

Field	Culture	Depth Moisture Average-Inches	Maximum Inches	Minimum Inches
G-3	Continuous wheat	32	39	24
	Stubble-mulch tillage			
G-3	Fallow for wheat, fall 1946	36.8	43	33
	Stubble mulch tillage			
G-2	Continuous wheat	30.7	35	24
	Oneway tillage			
I-1	Native pasture	29.2	34	26
	Moderately grazed			
Bush	Native pasture	27.5	33	24
	Heavily grazed			



"The great variation in the depth of penetration is probably due to the prolonged drought previous to the rains which caused wide cracks in the soil some of which were 3 to 4 inches wide with many 1 to 2 inches wide."

Experimental Orchard - John T. Bregger, Clemson, South Carolina.-

"Orchard cover crops were planted during late September following a good rain. Favorable October rains have resulted in a fine stand of rye, vetch and other legumes. Southern spotted burr clover has given the best ground coverage so far, with crimson clover second. A second advantage of these two species is the fact that they require no artificial reseeding. Volunteer reseeding of crimson clover without cultivation has taken place over a period of seven consecutive seasons. In the case of southern spotted burr clover, summer cultivation appears to increase the stand in that it holds down the growth of crabgrass which chokes out the burr clover when it gets too thick due to increased fertility.

"A summary of 1946 peach yields has been prepared on plots in the Experimental Orchard Annex planted in 1941. As in the older block, the hairy vetch plots show the highest fruit production followed by treatments which provide less additional nitrogen. The only other practice showing a higher yield than clean cultivation is a reseeding summer cover crop of *Crotolaria spectabilis*. The advantage of excess of nitrogen on young trees is clearly shown. When cover crops are introduced containing non-legumes in whole or in part, the yield goes down. Annual lespedeza also reduced yields to a significant degree, though not so much when spring tillage was given. Spotted burr clover has also reduced the yield, probably due to the omission of spring cultivation. Mowing appears to be superior to cultivation in the management of a rye cover crop, no doubt associated with a lessened nitrate tieup. (See Table)."

Effect of various cover crops and other soil management practices on the yields of 5-year-old peach trees

Soil Management Practice	Average Yield Per Tree
Vetch winter cover crop - spring tillage	4.6 bushels
<i>Crotolaria spectabilis</i> - spring tillage	4.0 bushels
Clean cultivation (all season)	3.8 bushels
Soybeans-Sudan grass summer cc, spring tillage	3.3 bushels
Korean lespedeza - spring tillage	3.2 bushels
Korean lespedeza - no tillage	2.8 bushels
Korean lespedeza with rye disked in (fall)	2.9 bushels
Rye winter cover crop - spring mowing	3.2 bushels
Rye winter cover crop - spring tillage	2.7 bushels
Southern spotted burr clover - volunteer reseeding	2.8 bushels

Average yields based on three replicated plots of four trees each.

Brush Eradication - Harley A. Daniel, Guthrie, Oklahoma.-"The treatments made with the 2,4 D sprays in April and during the extremely dry period gave poor results. They were fairly effective, however, when applied during rainy seasons to vegetation in a growing condition. The 2,4 D's did not affect native grass.

"Ammate spray produced good defoliation of all species treated. In a few places, new leaves developed on the old wood along the main stem of the plants. But a second application usually killed the new shoots. Ammate also killed most of the native grasses. There is a tremendous interest in these sprays and more information is needed."

Field Trials with Use of Rotary Subsoiler Lead to Big Demand For This Machine - Hugh C. McKay, St. Anthony, Idaho.-"The use of the rotary subsoiler, which leaves holes 24 inches apart and 14 inches deep, for erosion control is spreading as fast as machines are available for purchase. The manufacturers cannot keep up with the demand for this machine. There has been 11,000 acres of ground gone over in this area this fall to date. This includes both stubble land and summer fallowed ground seeded to fall wheat. For the larger farmers with units of three hooked together the operation costs approximately 25 cents per acre, they receive a 25 cents per acre payment from the triple A which just pays for the cost of operation.

"The widespread acceptance of this practice has resulted from one field trial put out last year in cooperation with the operation division. A close check is being kept on all farms where the rotary subsoilers are being used."

Microflora Increased Soil Nitrogen and Added Organic Matter - Joel E. Fletcher, Tucson, Arizona.-"Microflora growing in the surface crust of soils at the Valley Citrus Farm of the University of Arizona, while fixing nitrogen to two or three times its former level, also added as much as 1500 pounds of organic matter per acre."

Aggregation, Organic Matter and Erosion - Dwight D. Smith, Columbia, Missouri.-"Aggregation and organic matter determinations for the 1946 corn plots have been completed. Stability of aggregation increased with increased organic matter. Soil loss during the early growing period tended to increase as the stability of aggregation decreased."

Hunting A "Champion" Soil Aggregator - Henry Hopp, Beltsville, Maryland.-"The capacity of various species of earthworms to form water-stable aggregates was tested. Among them was the so-called "hybrid" worm, which is sold commercially as a soil improver. The results were as follows:

Species of Earthworm	Grams of Aggregates Deposited on the Surface of the Soil Per Day	Percentage Water Stability
Helodrilus chloroticus	.09	22
Helodrilus foetidus	.10	56
Helodrilus caliginosus	.12	31
"Hybrid"	.28	39
Diplocardia sp.	.32	17
Lumbricus rubellus	.68	22
Lumbricus terrestris	1.04	42

"The 'best' species was Lumbricus terrestris, which daily aggregated over a gram of soil, having a relatively high degree of water-stability."

More About Earthworms on Eroded Soil - "In last month's report we described how earthworms apparently formed topsoil from eroded soil and litter. We now find that earthworms may prosper on such a mixture. A mixture of eroded soil and litter was tested against other soils of the same type but having different fertility levels. The changes in body weight over a two-week test period were as follows:

Diet Offered to Worms	Change in Body Weight
a. Soil from a sericea field	100 (base)
b. Soil from a woods	104
c. Soil from an eroded bank	101
d. Same as 'c' but with lespedeza litter added	124

Needs for Further Research in New Mexico - D. S. Hubbell, State College, New Mexico.-"Some very enlightening information resulted from the recent survey of research needs. The questionnaires showed that there were over 100 problems over the state which require the attention of the Research Divisions. Of this number, over half of the suggested problems were common to all sections of the state. One of the most urgent requests for information was concerned with water spreading. On this subject there were 35 specific requests involving over 1,500,000 acres of land. The most numerous requests for research in general were for studies on range lands. The final results of the survey will no doubt be sent to the Washington Office by the President of the College, since the State Experiment Station is conducting the survey."



Relation of Past Erosion and Cover Crops to Cabbage Quality - E. A. Carleton, Geneva, New York.-"Cabbage harvested October 15 from the cover-crop experimental area showed striking differences in the number of split heads which were not marketable. The area is divided into three equal parts with regard to the slope of the land. One-third has been seeded to domestic rye grass the first of August for the past three years. Another third has been sown to winter rye after harvest, and one-third has only the crop residues disced in after harvest. The proportion of cabbage that were split at harvest time are tabulated below in relation to position on the slope and the cultural practice since 1944. The top third of the area has been severely eroded in the past. The middle third has been moderately eroded, while little erosion and even some silting has occurred on the bottom third.

Proportion of split cabbage in relation to slope and cultural practices

Position on slope	Cultural Practices		
	Domestic rye grass	Winter rye cover	No cover, residue disced in
	Percent	Percent	Percent
Top third	31	50	47
Middle third	44	42	61
Bottom third	6	7	50

Relation of Past Erosion and Cover Crops to Yield and Size of Canning Beets - "In the July 1946 report, a relation of high intensity rainfall, surface puddling of soil and the emergence of beet seedlings was discussed. The area where the measurements and observations were made was harvested October 8, and the beets weighed and counted. For the purpose of record and because position on the slope shows the greatest variation, the data presented below are tabulated for three positions on the slope for each cultural treatment. In the canning industry small size is demanded. Growers depend on heavy seeding and thick stands to get small sized beets. Surface puddling and hard surface crust resulting from high intensity rainfall on soils that have been eroded or are in poor physical condition, defeat the grower in an effort to obtain the best quality beet.

Beet yields in terms of weight, number and weight per beet.

Position on slope	Cultural Treatment					
	Mixed legume	Field brome	Domestic rye grass	Oats	Fallow	Sudan grass
Weight per 100-foot row, pounds						
Top	108	131	115	102	104	90
Middle	168	184	141	165	139	102
Bottom	131	139	124	112	120	120
Number of beets per 100-foot row						
Top	200	175	225	225	145	183
Middle	672	502	588	420	235	358
Bottom	612	605	455	460	429	398
Average weight per beet, pounds						
Top	0.54	0.75	0.51	0.45	0.72	0.49
Middle	.25	.37	.24	.39	.59	.28
Bottom	.21	.23	.27	.24	.28	.30

# DRAINAGE AND WATER CONTROL DIVISION

Hydrologic Studies - L. L. Harreld, North Appalachian Experimental Watershed, Coshocton, Ohio. - "Rainfall of 4.26 inches for the month caused only slight amounts of runoff - the most from any one watershed being 0.019 inch. This watershed had a good meadow seeding following wheat in this year. This watershed has numerous gullies and a few seep spots. Other watersheds with the same type vegetal cover had no runoff.

"Most of the runoff resulted from about 1 inch of rain on October 18. The maximum 5-minute rainfall rate was 2.64 inches per hour. Were it not for the fact that almost 0.9 inch of rain fell on October 17, all of which went into the ground, there probably would not have been any runoff from the October 18 storm. Preceding the storm of October 11 - 12 when 1.48 inches of rain fell, the soil-moisture content of the 0-40-inch soil profile had reached a minimum for the year. From October 10 to October 31, the moisture in this profile increased almost 4 inches..

"Soil samples were obtained on the corn plots on October 14, for the determination of non-capillary pores and the plant-residue content in the 0-1-, 1-4-, and 4-7-inch depths. The following results were obtained:

Soil : depth :	Plant residue content		Non-capillary pores	
	Plowed	Disked	Plowed	Disked
	Lbs/acre inch	Lbs/acre inch	Percent	Percent
0-1	234	734	23.1	24.1
1-4	152	952	22.1	23.7
4-7	243	337	19.1	19.0

"Rapid progress was made in preparation of cornland watersheds for wheat seeding. By the end of October the wheat had shown good growth.

"In connection with a pasture improvement program, part of a poverty grass and briar field was plowed and wheat seeded. After the wheat and fertilizer had been drilled, the spouts were removed from the drill and brome grass (9 pounds per acre) seeded through the grain box. The brome seed fell on the ground surface. The land was finally cultipacked. By the end of October both the wheat and the brome showed very good growth. The remainder of this pasture field will be seeded to alfalfa-brome in the spring by the trash mulch method.

"The Ohio Department of Education and the Ohio Conservation Commission co-operating, started an experimental educational program on conservation. Coshocton County was selected as one of their trial areas. This experiment station was represented at two of their meetings, October 10 and 24. Some of the hydrologic relationships developed here were presented."



Hydrologic Studies - J. A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebraska.-"The October rainfall measured 4.11 inches at the Meteorological Station which is 2.66 inches above normal for the month and brings the accumulated monthly rainfall to 2.81 above normal for the year. This is the wettest October on record; with the exception of 1897 which had 5.82 inches.

"Between October 5 and 11, 3.63 inches of rain fell with the largest catch of 1.51 inches on October 5. Because of the moderate intensities, the peak runoffs were not excessively high, but the runoff duration was fairly long. Considerable sheet erosion was noted on the wheat fields especially on the plowed fields which offered very little protection against erosion.

"Following is a table showing the inches of water on meadow and cultivated areas as computed from the soil-moisture samples taken between August 20, and October 21, 1946.

Date	Meadow			Cultivated		
	0-1' depth	0-3' depth	0-6' depth	0-1' depth	0-3' depth	0-6' depth
Aug. 20	2.58	6.96	14.71	1.99	6.47	14.32
Sept. 5	2.22	5.84		2.19	6.37	
Sept. 20	4.90	10.84	18.34	3.89	8.78	16.48
Oct. 9	5.46	13.04		4.15	8.78	
Oct. 21	4.92	13.04	20.99	4.28	10.40	17.85

Hydrologic Studies - R. B. Hickok, Lafayette, Indiana.-"Corn watersheds were sample harvested between October 10 and 15. The following table shows the yields by watersheds and treatments:

1946 Corn Yields on Experiment Watersheds, under Prevailing and Conservation Treatment, Purdue-Throckmorton Farm, Lafayette, Indiana

Treatment <sup>1/</sup>	Watershed No.	Yields <sup>2/</sup>
		Bu./A.
Prevailing	5	93.28
	8	109.13
	Average	101.2
Conservation	6	134.16
	7	121.95
	Average	128.0

<sup>1/</sup> Prevailing treatment consisted of check planting, with 150 lbs. of 0-14-7 fertilizer applied with seeding, red clover-timothy plowed under. Conservation treatment included contour-drilled planting, with 1,000 lbs. of 8-8-8 fertilizer, 6 tons of manure and alfalfa-red clover-alsike-timothy meadow plowed under.

<sup>2/</sup> Yields computed at 17.5 percent moisture.

"This year's corn watersheds have been under differential treatment for 4 years, this being their second corn crop since the beginning of the experiment. The 1943 average yields of these watersheds were 55 and 88 bu./A., for prevailing and conservation treatment, respectively. Average rainfall less runoff during the 1943 crop season were 17.29 inches for the prevailing treatment and 19.62 inches for the conservation treatment; compared to 17.73 inches and 18.19 inches, respectively, this season. While distribution of rainfall over this corn season was more favorable than in 1943, it is believed that the increased yields this season over those in 1943, for both prevailing and conservation-treated watersheds, was due largely to other factors than moisture availability. Corn yields in the county will apparently average considerably higher this year than in 1943. However, the difference in favorableness of the seasons will not be sufficient to account for more than a small part of the increase in yields on the watersheds. Thus, it is believed that accumulative improvements in productivity have accrued under both the prevailing and conservation treatments. The cropping on the Throckmorton Farm had been essentially continuous grains, with no legumes plowed under, prior to the beginning of the experiment.

"The crop rotation on the experiment watersheds is being changed from C-W-M to C-Sb-W-M beginning with soybeans on one set of watersheds this season for the first time. The beans were sample harvested on the watersheds between October 8 and 15. The yields by watersheds and treatments are shown in the following table:

1946 Soybeans Yields on Experiment Watersheds, under Prevailing and Conservation Treatment, Purdue-Throckmorton Farm, Lafayette, Ind.

Treatment <sup>1/</sup>	Watershed No.	Yields <sup>2/</sup> Bu./A.
Prevailing	13	14.5
	10	13.18
	15	10.31
	Average 10 and 15	11.7
Conservation	14	6.34
	18	9.98
	Average 14 and 18	8.2

<sup>1/</sup> All beans were drilled in 28 inch rows. The prevailing treated beans were sown in straight rows. Conservation-treated beans were drilled on the contour. Residues of previous corn crop were disked down on all the bean watersheds. No fertilizer was applied to beans under either treatment.

<sup>2/</sup> Yields computed at 13.5 percent moisture.

"While bean yields in the locality were somewhat lower than normal, the crop failure on the watersheds was due mainly to insufficient stand and inadequate weed control. Lower yields from the conservation-treated watersheds than those under prevailing treatment is attributed to the obviously greater weed infestation of the former, resulting from their higher fertility level.

"The plant spacing in the rows averaged about 3 inches; whereas Purdue Experiment Station reports maximum yields with Richland beans in 28 inch rows with approximately 1 inch spacing in the rows. The rate of seeding was much too low and the germination and survival poor. The stand would have been considerably improved by use of a rotary hoe before and during the time the seedlings were coming up.

"Cultivation was delayed. However, it is significant that at the time of harvest there were relatively few weeds between the rows and heavy weed growth in the rows. Timely rotary hoeing from the time of seeding until the beans were about 6 inches high was needed for control of weeds in the rows and to reduce the need for cultivation between the rows. Variation in spacing of drill strips, resulting in alternate wide and narrow rows between drill strips, made it impossible to completely cultivate the wide rows and necessary to cultivate out many beans in the narrow rows. Insufficient stand to shade weeds in the rows also aggravated the weed situation.

"Satisfactory bean yields may be expected from rowed beans with proper management, and cultivation is considered important from the standpoint of obtaining the maximum soil and moisture conservation with contouring."

Hydrologic Studies - R. G. White, East Lansing, Michigan. - "Precipitation for the month of October measured 2.16 inches at the cultivated watersheds, 2.21 inches at the stubble-mulch plots, and 2.15 inches at the wooded watershed, as measured by the Standard U. S. Weather Bureau type non-recording rain gage. The 40-year average for October for East Lansing is 2.39 inches. There was no runoff or soil loss during the month.



"The 1946 crop yields for wheat, oats, and clover for the stubble-mulch culture plots have been determined, and are given in the following tables. For comparative purposes, 1943, 1944, and 1945 crop yields are also shown.

### Wheat, Stubble Mulch Culture Plots

	Tillage Treatment			
	Plow	Disk	Sweeps	Plow, mold-board removed
1943, grain, bu. per acre	27.8	21.1	19.8	24.5
1944, " " "	39.5	37.7	37.4	36.6
1945, " " "	48.5	43.5	41.0	46.9
1946, " " "	46.1	35.2	33.1	41.5
Average	40.5	34.4	32.8	37.4
1943, straw, lbs. per acre	3,093	2,351	2,679	2,669
1944, " " "	4,284	4,347	4,129	4,268
1945, " " "	6,165	4,714	4,586	5,432
1946, " " "	4,342	3,390	3,363	4,058
Average	4,471	3,700	3,689	4,107

Each year of the 4 years this experiment has been in progress, plowing has given the highest yield for wheat. Generally, the plow with moldboard removed takes second place, with the disk in third place, and sweeps in fourth place. However, for 1943, 1944, and 1945, the maximum variation in yields for any one year was quite low, and it was felt that even though sweeps did produce the lowest yield per acre, the savings in the cost of seed-bed preparation was great enough that over a period of years, it would offset the increase in yield obtained by plowing. In 1946, however, plowing out yielded sweeps 13 bushels per acre, which is indeed a significant increase.

### Oats, Stubble Mulch Culture Plots

	Tillage Treatment			
	Plow	Disk	Sweeps	Plow, mold-board removed
1943, grain, bu. per acre	51.1	14.8	21.1	32.9
1944, " " "	39.9	36.9	38.4	36.8
1945, " " "	51.1	52.5	49.9	55.6
1946, " " "	78.6	64.8	61.6	70.1
Average, 1943-44-45-46	55.2	42.2	42.8	48.9
Average, 1944-45-46	56.5	51.4	50.0	54.2
1943, straw, lbs. per acre	4,185	2,805	2,844	2,719
1944, " " "	2,702	2,634	2,959	2,814
1945, " " "	4,597	4,226	4,181	4,670
1946, " " "	2,685	2,271	1,999	2,511
Average	3,542	2,984	2,996	3,179

Except for 1943, there has been no significant difference in oat yields under the four types of tillage. The yield advantage is slightly in favor of plowing, but not enough to justify the additional cost of seed-bed preparation. The 1943 oat crop (first year of the experiment) followed rye instead of corn, as has been the case in subsequent years. Plowing was the only method of seed-bed preparation that successfully controlled weed growth during 1943, and the wide variation in yields under the four types of seed-bed preparation reflects competition with weeds.

#### Clover Hay, Stubble Mulch Culture Plots

	Tillage Treatment			
	Flow	Disk	Sweeps	Flow, moldboard removed
1944, lbs. per acre	3,450	2,972	3,215	3,399
1945, " "	3,326	3,279	3,063	3,187
1946, " "	3,061	2,821	2,968	3,243
Average	3,279	3,024	3,082	3,276

"The type of tillage equipment used in seed-bed preparation seems to have very little effect on the yield of clover hay. It has been noted, however, that hay from the plowed plots was considerably less contaminated with weeds than was the hay from the plots tilled with the disk or sweeps."

Hydrologic Studies - R. W. Baird, Waco, Texas. - "Rainfall at station 69 for the month of October totaled 1.61 inches. There was no runoff from this rain. The rainfall since the 28th of August has totaled 8.07 inches and has almost satisfied the soil-moisture deficiency caused by the hot dry weather from the 21st of July to the 28th of August.

"Pastures and fall planted crops have responded well to this rainfall. The fall legumes, burr clover, Hubam clover, Austrian winter peas, and some of the native vetches are making good growth. Oats are growing well. In a few fields extensive damage has been done to oats by 'false army worms.' This damage has occurred only on those fields where oats were planted in cotton stalks without any seed bed preparation."

Runoff Studies - N. E. Minshall, Madison, Wisconsin. - "Precipitation for Edwardsville for the month was 4.23 inches as compared to a normal of 3.2 inches. Of the total precipitation 2.63 inches came on the last day but resulted in only about .2 inch of runoff due to the low antecedent moisture condition. The total precipitation for two and a half months preceding this storm was only 3 inches. The storm period of October 31 extended into November 1. During this storm there was a total precipitation of 6.11 inches in 36 hours. The total runoff for the storm was approximately 2 inches. There were no high intensities and peak rates of runoff were low. Temperatures varied from a maximum of 86 degrees on the 7th to a minimum of 28 degrees on the 12th.

"Precipitation for Fennimore for the month was 2.89 inches as compared to a normal of 2.3 inches. There were no periods of high intensity and no surface runoff. Some records of winter runoff during the past few years have been lost by the float freezing in. In an attempt to prevent further loss of records, we have removed the water and mud from two of the stilling wells, painted them with asphalt paint, and placed one hundred pounds of salt in the bottom. If this method of keeping the stilling wells open during the winter should prove satisfactory, it may be extended to the other watersheds.

"About one week was spent examining structures in La Crosse county, but due to the amount of travel necessary and the small number examined, no conclusions can be drawn at this time. In general, however, the structures which were studied appeared to be in good condition and performing satisfactory."

Hydraulic Studies - F. W. Blaisdell, Minneapolis, Minnesota.-

"Mr. Anderson tested the 1-1/8-inch pipe drop-inlet spillway model with no circulation in back of the headwall. A series of 18 runs was made using the photographic method of simultaneously recording the flow conditions within the structure and the piezometer readings.

"The data from the 4-1/2-inch, 2-1/4-inch and 1-1/8-inch models were analyzed and a corrected head-discharge curve computed. When the data obtained from the three models were corrected for differences in pipe friction between the models, a single curve for pipe-flow conditions was obtained. The maximum deviation of any point from a curve drawn through the data points was 2.3 percent, and the average deviation 0.7 percent. The head losses through the structure were found to be  $0.75H_{vp}$  in excess of the pipe-friction losses, where  $H_{vp}$  is the velocity head in the pipe. The discharge through a structure similar to the one tested may, for pipe flow conditions, be computed assuming that the losses are equal to  $1.75H_{vp}$  plus the friction losses.

"A second rating curve was obtained for the period prior to the time in which the pipe flows full; that is, for the condition of weir flow on the inlet. The average deviation of the data from this curve was 2.2 percent with a maximum of 6.0 percent for all three models.

"A comparison of the local pressure variations in the riser and pipe for pipe-flow conditions showed excellent agreement between the three models except for a distance of about four diameters below the junction of the riser and the pipe. In this region the ratio of  $H_n/H_{vp}$  for the 1-1/8-inch model was approximately 20 percent lower than for the 2-1/4-inch and 4-1/2-inch diameter models. Here  $H_n$  is the variation of the local pressure from the computed friction grade line. At all other points this ratio was practically identical for all models. Minimum pressures were observed on the top of the pipe one-half pipe diameter downstream from its



junction with the riser. At this point the average pressure reached a minimum value of  $1.3H_{vp}$  below the friction grade line.

"Excellent agreement of the piezometric pressures between the three models was obtained when the pipe was flowing partly full. The agreement of piezometric pressures between the three models was good with a mixture of air and water in the pipe, even though, due to the differences in model size, different amounts of air were present in each model. It was for this latter condition that the greatest differences were expected.

"The slope of the pipe for the tests reported here was 1 on 3. The riser is  $1.24D$  square and  $5D$  deep and has a headwall  $2D$  high by  $3D$  wide. An additional wall, equal in height to the headwall, runs from the back of the headwall to the downstream end of the headpool. This wall stops circulation of water in back of the headwall and improves the flow pattern at the inlet; it also results in better rating curves and a better comparison of rating curves between models. The width of the approach channel for all models was  $10.5D$ .

"Several years ago, shortly after the study of pipe drop inlets was initiated, Mr. D. A. Parsons stated to the writer that the solution to this problem would possibly be quite simple. At that time the difficulties seemed almost insurmountable and the complicated flow conditions within the structure seemed to defy human understanding. The progress since that time, which has culminated in the significant advance made recently, is encouraging. It appears that Mr. Parsons' prophesy is at last being realized.

"A report entitled 'Report on Hydraulic Model Tests of Outlet Structure to be Built at Lower Caney Lake, Minden, Louisiana' was reproduced and submitted to the Washington Office on October 25."

Hydraulic Studies - W. O. Ree, Stillwater, Oklahoma.--"The routine channel tests for the fall season were completed this month. The experiments run during October include:

Table 1

Chan.	Expt.	Cover	Bed : slope	Bottom : width	Side : slopes	Number of flows
U2	4	Bermuda grass, green, short	0.05	3	1/	8
U3	7	Bermuda grass, green, short	.05	3	1/	8
U7	2	Lovegrass, green, long	.05	3	1/	13
U10	2	Sudan grass, green, long	.05	3	1/	14
L1A	3	Bermuda grass, green, long	.04	10	4:1	11
L1B	3	Bermuda grass, green, long	.09	10	4:1	11

1/ Vertical plywood sides.

"After having been with this project for almost 5-1/2 years, Mr. V. J. Palmer has been transferred to Ithaca, N. Y. During most of the war years, Mr. Palmer served as project supervisor of this project.

"Experiment 2 was the second run on channel U10 this year. The previous experiment was run in July and the results reported in the August, 1946, Monthly Progress Report. In October the channel had changed some in appearance in that the Sudan grass had matured, but it still had about the same average height and density of cover. This main change had occurred near the bed of the channel. There was more dead material and debris than there had been for the July tests. As a result the  $n$  values for the low flows were from 30 to 50 percent higher for experiment 2. For the higher flows the  $n$  values for the two experiments approached equality. The retardance coefficient for the two experiments are compared in the following table.

Table 2

$VD^{1/}$	Expt. 1 (Manning's $n$ )	Expt. 2 (Manning's $n$ )
0.005	-	0.37
.01	-	.30
.05	.13	.20
.10	.145	.20
.5	.19	.29 (Highest value)
1.0	.165	.225
5.0	.068	.075

$1/$  Product of velocity and depth of flow.

Drainage Studies - R. E. Morris, North Liberty, Indiana.-

"Early in the month work was begun on a study which is designed to show more accurately the action of drain tile in muck soil. The movement of the water table in the respective areas adjacent to a series of tile lines is being studied and records kept on these movements as water is removed and brought into these areas via the tile lines. The study is being made in the eastern one-half of four of the controlled drainage plots. Of necessity this work could not be conducted during the growing season since excessive movement of the water tables then would interfere with the crop yield-soil moisture relationship experiments. Such an arrangement makes it possible to observe the action of eight different tile lines which were installed at three different depths in the spring of this year. Each line serves an area 110 feet long and 50 feet wide. There are 26 observation wells serving each set of two tile lines. Admittedly there is insufficient width of land per line to permit an exhaustive and conclusive study. Nevertheless, it should be possible to obtain some useful information."

Drainage Studies - James Turnbull, Lake Alfred, Florida.-

"Measurements were continued to determine interception of rainfall by tree canopies and data are now available for 31 separate rains. Early in the summer a number of shallow holes about 8 inches in diameter were dug under several trees to determine whether such holes would have any effect on the 'dry bodies' under the trees. Inspection of these holes during the month revealed that in no instance was there any evidence of a 'dry body' under any of the test holes. There was no apparent tendency for the wetting effect to spread laterally beyond the limits of the depression, however, since dry sand was frequently encountered immediately adjacent to the test holes. The prolonged rainy season with its higher than average rainfall seems to have reduced the area of 'dry bodies' under the trees.

"Water table wells continued to drop during the month and the water table in two of the wells, one at 150 feet and one at 238 feet from the lake, is now lower than the lake elevation."

Drainage Studies - C. K. Davis, The Everglades Project, Fort Lauderdale, Florida.-"We had about six inches of rain within a twenty-four hour period during the first part of the month and about 50 percent of the bean crop was destroyed. It is these flash rains which cause damage in the upper 'glades and it is during the flash rains that the value of 1/8-mile ditch spacing, over the 1/4-mile ditch spacing, shows to a decided advantage. The water table was lowered quickly on section 10 where the ditch spacing was 1/8-mile, and very little damage resulted from the intense rainfall. It is during these flood periods that additional pumps strategically located are needed so that it will not be necessary for all of the water to be pumped through a central pumping station. I do not believe it is advisable to attempt to control the movement of water in the main canals for a distance exceeding two miles."

Drainage Studies - M. H. Gallatin, Homestead, Florida.-"During this month differences in moisture on the mulch plots began showing up. While the grass, shavings and pine straw maintained moisture very well, the plot with natural cover was just about the same as the check plot from which all cover is removed. The results to date indicate that mulch is essential in this area.

"The installation of our pump was completed about the middle of last month and since that time we have been carrying on this test. Indications are that there is very little lateral movement of water in these marl soils. We hope to get our shallow internal drainage in after the cropping season so that the movement of surface water can be increased. In checking our pumped area against adjacent lands our area was dry enough so plowing could be started while the other adjacent areas still had water to ground surface or above."



# IRRIGATION DIVISION

Irrigation Efficiency Studies.-Aronovici reports two sets of irrigation-efficiency runs in the Antelope Valley. The first set was on medium textured soils and the second on very light textured soils. "It was found that the irrigation efficiency for a given set of field conditions such as grade, head, and length of run are very materially affected by the moisture content of the soil prior to irrigation. An interesting comparison of these two irrigation runs may be briefly summarized in the table below:

Run	: Total : : application: : : Ac. in/ac.: : : 0-24 in. :	Pw before : : irrigation: : : 0-84 in. :	In gain : : Ac. In/Ac.: : : 0-84 in. :	: Time required : : to reach 6 / 100: : : Minutes :	: Irrigation : : efficiency : : Percent
First run	4.32	7.5	3.96	129	92.0
Second run	3.96	9.8	2.90	116	73.3

"It is observed from these data that the establishment of an ideal irrigation grade, width of border, length of run, etc., is only part of the picture. There is a need for study of the most suitable moisture level at which irrigation will be the most efficient and still maintain maximum production of the crops.

"The second irrigation-efficiency investigation conducted on the very light textured soil was somewhat less successful. Irrigation efficiencies obtained were, as expected, very low when the irrigation grade and head was insufficient, less than 54 percent, while reasonably high with adequate grade and head. Again the moisture content of the soil affected the degree of efficiency. Insufficient data are available at this time to state just what would be the optimum moisture condition."

Evaporation - Transpiration Losses - Blaney reports.-"The Division of Irrigation and Water Conservation has recently completed an investigation of evapo-transpiration and possible water conservation in the lower Santa Ana River, in cooperation with the Orange County Water District and the United States Geological Survey. The results of this investigation are presented in a report entitled, 'Water Losses in the Santa Ana River Canyon Below Prado Dam, California,' by Dean C. Muckel and Harry F. Blaney.

"This report includes an estimate of consumptive use of water in Santa Ana Canyon; a discussion of the variations of evaporation and transpiration which might be expected owing to climatic changes and to changes in the vegetal cover of the valley floor; an estimate of the amount of water now being consumed annually by non-economic plants which can be feasibly salvaged and converted to beneficial use during the irrigation season; and a discussion of the conditions necessary to permit salvage of the water and a method by which it might be accomplished. Data and information are presented on the rate of evaporation from soils and free water

surfaces; rates of water use by plants, both cultivated and native; ground-water levels; area and extent of water-using lands; and effect of Prado Dam on the future vegetal cover of the valley floor.

"The normal annual evapo-transpiration losses in the Santa Ana Canyon, between Prado Dam and the Santa Ana Valley Irrigation Canal intake, are estimated as 4,500 acre-feet. It is estimated that about 1,400 acre-feet of this water may be salvaged in normal years for irrigation use. It has been estimated that this water is worth, conservatively, \$10.00 per acre-foot per year. This represents an annual dollar value of \$14,000 per year. The irrigation companies are adopting the methods of water salvage suggested in this report."

Infiltration from Precipitation.-Aronovici reports the results of an emergency study, made at the request of the San Bernardino Flood Control Department, covering the Red Hill Watershed.

"On September 29, an exceptionally heavy thunderstorm struck this area. In this vicinity rainfall intensities reached a maximum of 3.2 inches of rain in 80 minutes. Heavy runoff occurred with resulting severe erosion of some of the orchard lands and channels. In an effort to establish the total quantity of water retained by the soil and the total discharge, a series of selected soil moisture and volume weight samples were taken. Depth of penetration was also observed.

"From these data it was estimated that approximately 1.00 to 1.10 inches of rain was retained by the soil with the balance as runoff."

Determination of Area Water Needs and Yields.-Muckel reports the procedure for determining the water requirements and natural water yield of a given valley:

"Escondido: In connection with the Escondido project, which has to do with the determination of the safe yield of Escondido Valley, data were collected on the monthly amount of water imported during the past 15 years. These were plotted to determine the trend of usage of this water; there has been little change. In order to arrive at the trends in the use of locally developed water, power records were obtained and plotted for the same period of years. There is not sufficient information available to convert power to water pumped but it is believed the power usage should indicate at what rate the draft on the ground water supplies is increasing. Since 1932 the power use has more than tripled with the most rapid increase occurring since 1941. Crop-survey data indicate that avocado acreage is increasing and citrus acreage is decreasing slightly. This means an increase in water demand as avocados require about 2.50 acre-feet per year and citrus about 1.50 acre-feet per year."

Water Spreading.-Mitchelson reports considerable success in recharging a ground-water aquifer through a well on the Merritt and Ochletree property near Madera, Calif. This well was intended as a pump well, but was considered unsatisfactory and was utilized as an experimental recharge well. It is 85 feet deep, and 14 inches in diameter. A 65-day record of operation showed average intake of 4.5 acre-feet and a maximum intake of 13.92 acre-feet per day. Two other wells drilled and operated by the Madera Irrigation District were quite unsuccessful. Former studies by the Division indicated that water spreading through pump wells had very limited application.

Snow Surveys.-Frost reports, "April-September runoff in Oregon for 1946 closely approximated the April forecast." He pointed out that on the Crooked River drainage our forecast of inflow to Ochoco Reservoir of 285 percent normal made possible the seeding and irrigating of 4,000 acres not normally seeded. County Agent E. L. Woods estimates that crops produced on these lands are conservatively valued at \$400,000.

In the Deschutes area we forecasted water supplies from 126 to 206 percent normal. County Agent Gene Lear reports that about 2,500 acres were seeded and irrigated which otherwise would not have been planted, and that the cash value of crops produced from this land was approximately \$250,000.

Marr reports April-September runoff in Idaho closely approximated the April 1 forecasts. The following description of conditions in Idaho during 1946 clearly illustrates the value of irrigation research and water-supply forecasts:

"As a result of the water-supply forecast based on snow surveys during the spring of 1946, flood damage on Kootenai River was very largely avoided. In the April 1, 1946, Snow Surveys and Irrigation Water Supply Forecasts for the Columbia Basin, it was forecast that the April to September runoff for 1946 would be 9,800,000 acre-feet, which was very close to the maximum of record. A warning was given that flood-protection measures were warranted. Mr. Crocker, who was then Secretary of the Kootenai Valley Reclamation Association, used this forecast as the basis of a request to the Army Engineers for assistance. When the floods came, the Army Engineers responded by assigning some 700 soldiers with heavy equipment to help hold the dikes which protect the 37,000 acres of farm land in Kootenai Valley. Weaknesses in the dikes for 17,800 acres of the area developed and were successfully strengthened. It is debatable that such success in combating the Kootenai River floods of 1946 could have been attained without the assistance of the Army Engineers, and it is debatable whether this help could have been given without the preparations that were made possible by the forecasted high water. The loss which would have been experienced had the dikes broken is difficult to estimate.



Most of these lands during good years should produce at least \$100 in crops annually, and it is probable that they would have been out of production for 2 years had they been flooded. This loss added to the cost of repairs would have amounted to at least 4 or 5 million dollars.

"Another benefit which showed up as a result of the 1946 water forecast of the Kootenai River concerns the undiked lands in Kootenai Valley. The owners of some 2,000 acres of such lands have been farming their holdings for the past few years in accordance with the water-supply forecasts based on snow surveys. During 1944 and 1945 they planted their lands and made good crops because the forecast was for a low river. They refrained from planting in 1946 because of the danger of a high river and the consequent flooding of their holdings. Their lands were submerged by from 2 to 3 feet of water during most of the growing season. All of their work and the seed would have been lost if they had not heeded the flood warning for this year."

"In the April 1 report for 1943 it was estimated that the annual runoff would be 3,400,000 acre feet. It was further pointed out that since 1895, only during 1896, 1904, and 1907 had the annual runoff of Boise River exceeded 3,000,000 acre-feet. The maximum during this period was 3,301,340 acre-feet during 1896. It developed that the runoff for 1943 amounted to 3,453,400 acre-feet. A warning of probable floods was given. The Governor of Idaho declared a flood emergency on Boise River and other watersheds. A great deal of work was done in various parts of the State and especially on the Boise River to alleviate the danger. Though very high water resulted and the damage that occurred was serious, the situation was kept from being a calamity."

Lining of Irrigation Canals and Ditches.-Rohwer reports, "Pool measurements of seepage losses on typical laterals on a potato farm at Greeley, Colo., indicate a loss of 3 cubic feet per square foot of wetted surface for 24 hours."

Sand Traps.-Parshall reports, "Continuation of tests on the model riffle deflector-vortex tube sand trap at the hydraulic laboratory. Pending the final design of this type of sand trap for the Consolidated Irrigation District canal, Selma, Calif., a liberal sample from the bed of this channel was sent to Fort Collins for test purposes. As based on dry weight samples the over-all efficiency of the model tests indicate a recovery of more than 90 percent. Two thirds of the total 25 Kilo sample was caught by the first upstream vortex tube. A model of this type of sand trap was built and operated at Selma for the purpose of demonstrating the principle to the members of the Board of Directors of the District and others interested in the problem of trapping bed load from artificial channels. This irrigation district has accepted the riffle deflector-vortex tube type of sand trap as the means of correcting the sand problem in their main 2,000 second feet canal. This structure will be 100 feet wide, water depth 7 feet, and about 75 feet long. It is probable that a 40-foot Parshall measuring flume will be constructed, joining the lower

end of the sand trap, as a means of gaging the discharge of the canal." The construction of this 2,000 cubic feet per second capacity sand trap by the Consolidated Irrigation District will provide a means of verifying or modifying the principles of sand-trap design developed through model studies at Fort Collins.

Pumping for Irrigation.-Rohwer reports results of preliminary tests on foot valves of irrigation pumps. These tests indicate heavy losses through check valves particularly at low discharges. He found losses through a 4 inch check valve with a discharge of 500 gallons per minute to be 25 percent of the total head. When discharge dropped to 50 gallons per minute the loss was 60 percent of the total head.

Flow of Water in Pipes.-Donnan reports, "A 40-acre plot which has been tiled is now being leached to remove excess soluble salts. After 70 days of continuous leaching the total dissolved salts in the leachate has dropped from an initial 17 tons per acre-foot to 8 tons per acre-foot. During the 70-day period approximately 250 tons of dissolved salts were removed from the plot by the tile system."

Hutchins delivered a paper before the National Reclamation Association entitled "Principles of State Water Legislation." This paper will be published by the National Reclamation Association. "This paper presents those principles of State water legislation, under the doctrine of prior appropriation, which the committee of which Hutchins is chairman, considered most desirable from an overall standpoint. Very little new untold material is included. Mostly, the principles presented are already part of the water law of various Western States and were selected on their individual merit."

Erosion from Irrigation.-Griddle, Mech, and McCulloch developed a curve for use in the Soil Decline Analysis. This curve shows the relationship between soil erosion and slope. For a silt-loam soil similar to that under study at Prosser, Wash., and near Logan, Utah, the erosion varies as a function of the slope squared. The amount of erosion on a 7 percent slope at the Prosser Station was quite similar to that found by the Utah work, although studies on 2 percent grade did not agree so well. For the purpose of the "Soil Decline" work, the final curve to be used is somewhat of a compromise. Under actual field conditions a number of major factors other than slope enter into the rate at which a soil erodes, and these factors were taken into consideration.

Silt Studies in Texas.-Bloodgood reports a summary of some of the suspended load silt studies in Texas: "The largest amount of suspended silt load from the present 25 stations in Texas was determined for the Richmond Station on the Brazos River. This amount was 0.732 acre-foot per square mile of contributing watershed. The total amount for the water year 1944-45 was 25,496 acre-feet based on 70 pounds per cubic foot."

During the past 21.3 years, 543,221 acre-feet of suspended silt load passed Richmond, a sufficient amount to have filled a good sized reservoir. The Brazos is a Central Texas stream.

"The least amount of suspended silt load was determined for the streams of East Texas where the topography is more regular and there is considerable vegetal growth to prevent erosion. The Rockland Station on the Neches River carried an average annual silt load of 0.088 acre-foot per square mile of contributing watershed. During the past 15.1 years, 4,694 acre-feet of silt has passed this station.

"The San Saba Station on the Colorado River passed a silt load of 3,360 acre-feet per year, or 51,000 acre-feet, during the past 15 years. This Station is located above Buchanan Dam (capacity 992,475 acre-feet). Inks Dam reservoir (capacity 16,200 acre-feet) is several miles below Buchanan Dam and backs water up to this dam. There is not any contributing watershed area between these two dams. The average annual amount of suspended silt load passing Inks Dam is 82 acre-feet, or 259 acre-feet for a period of 3.1 years. Still down the Colorado River are two more dams, the Marshall Ford (capacity 1,963,000 acre-feet) and Austin Reservoir (capacity 21,500 acre-feet). Several miles below the Austin Dam at Montopolis Bridge Station the average annual load since Austin was completed (5 years) is 270 acre-feet.

"The suspended silt load at South Bend Station on the Brazos River and located just above Possum Kingdom Dam (capacity 750,000 acre-feet) is 2,079 acre-feet (7,713 acre-feet for 3.7 years), while the average amount of suspended silt load passing Possum Kingdom Dam through outlet gates and over the spillway is 132 acre-feet.

"The average amount of suspended silt load at the Three River Station on the Nueces River is 523 acre-feet (9,417 acre-feet for the past 18 years and based on 70 pounds per cubic foot) while the amount passing Corpus Christi Dam (capacity 64,000 acre-feet) is 186 acre-feet. This amount passes the dam through outlet gates and over the spillway (no electric power is developed). The contributing watershed between the Three River Station and Corpus Christi Dam is about 1,000 square miles. The total contributing watershed area above Corpus Christi Dam is 16,660 square miles."

Runoff from Agricultural Areas.-Rouse reports: "An investigation into the probable rates of rainfall for intervals of 5, 10, 15, 30, and 60 minutes with expectancies of 25 years, based on the records of Runoff Studies projects including six gages at Colorado Springs and six gages at Vega, Tex., tend to conform the results reported by Yarnell (Misc. Pub. No. 204) as satisfactory for use in the High Plains in connection with large watersheds. It also indicates that purely local conditions, such as topography



and cover may induce local concentrations of rainfall with intensities considerably higher than those experienced generally over the surrounding area. The possibility of these higher intensities must be considered in connection with the smaller watersheds."

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